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Comparation between Surgical and Orthodontic Uprighting Procedures for the Management of Impacted Mandibular Second Molars: a systematic review

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Abstract

Mandibular second molars are one of the most frequent type of teeth to be impacted, after the third molars and maxillary canines. The prevalence of impacted second molars is low, varying from 0% to 2.3%; and the aetiology of impaction can involve multiple factors: systemic, local, and periodontal factors, as well as a developmental disruption of the tooth germ. For its frequency, this dental anomaly can require different kind of approaches: a single orthodontic treatment, a surgical approach or a combination of them.

Among the surgical and orthodontic treatment options suggested in the literature, we can find leaving the tooth in situ, removing the impacted second molar, orthodontic uprighting, and autotransplantation. Removal of third molars has been suggested as an adjunct for space creation.

In the orthodontic treatment, the center of rotation of the second molar lies in the bifurcation of the roots of this tooth, and this biomechanical property was used to its full advantage. The techniques applied comprised: bracket repositioning, bypass of brackets, conversion of molar tubes to brackets, thermoelastic copper-nickel-titanium archwires, and a pushcoil spring. Other orthodontic treatment mechanics can require complex sectional or segmental techniques, auxiliaries, or artistic wire bending. Sometime these mechanics have been suggested in the literature.

Nowadays, thanks to the introduction in the use of miniscrew in orthodontics, several cases of teeth impaction can be managed easily with a reduction of complications.

Introduction

Impaction of permanent teeth is a relatively common occurrence that can involve any tooth in the dental arch. The kind of teeth that generally impacted are the mandibular and maxillary third molars, followed by maxillary canines and, then mandibular second molars.[1] Mandibular second molars become impacted in 0.03 to 0.65% of adolescents and are usually detected at 11 to 13 years of age. These kind of teeth are different from the others because, as the first molars they are not preceded in first dentition by other teeth.

For the eruption of permanent molars, the tooth germ develops from the backward extension of the dental lamina.[2] Unilateral impaction of the mandibular second molar is more common than bilateral impaction. It occurs more frequently in the mandible, among male patients, and on the right side of the jaw. Impacted second molars are most often mesially inclined.[3] The 3 main causes of second molar disturbances are: an ectopic position of the follicle, obstacles in the path of eruption, and failure of the eruption mechanism.[4] In particular, alteration mechanisms are represented by: 1) inadequate space for eruption; 2) lack of guidance by the distal root of the first molar because of excessive distance between the first and second molars, possibly as a result of premature loss of a primary molar; 3) lack of mesial movement of the permanent first molar because of ankylosis of a primary molar.

It is important to diagnose this condition early so that treatment can begin at the optimal time. It is thought to be ideal to treat this condition during early adolescence, when second molar root formation is still incomplete and before complete development of the mandibular third molars. Treatment at this time has been found to improve the outcome.[5]

Some complications of the impaction of second molars include the development of pericoronitis, increased risk of caries and periodontal disease, risk of resorption of adjacent teeth by the follicle, and cystic development of the follicle.[6] Treatment modalities for impacted mandibular second permanent molars include orthodontic (with or without removal of third molars) and surgical repositioning (autotransplantation). Removal of the second molars to allow eruption of the third molars and autotransplantation of the third molars after extraction of the second molars have also been described in the

literature. Surgical repositioning of mesially impacted teeth, however, can be associated with some unwanted side effects, such as ankylosis, replacement resorption, and loss of tooth vitality. Some recent studies on the autotransplantation of third molars referred a successful rate of 11% in the patients[5], where, on the other hand the orthodontically assisted guided eruption is thought to be the treatment of choice for impacted second molars, with a success rate of 70%.[5] This procedure might be difficult if the tooth is too apical to the occlusion or horizontally positioned.

Several orthodontic treatment modalities have been suggested to guide the eruption of impacted second molars, including diverse spring designs often encompassing sectional or segmental mechanics.[7] Nowadays the improvement in the use of osseous anchorage through the mini-screw in retromandibular region has been applied also in the uprighting of mandibular second molars.[8] In this kind of procedure, a surgical exposure of the second molars or removal of the third molars can been required.

Alignment of the impacted molar can sometimes be obtained without surgical assistance because the orthodontic uprighting involves a distal tipping movement, which creates space for the impacted molar. However, interference with the third molar cannot be excluded.

Materials and Methods

During the years, several dentistry works have been published on international literature about the incidence of maxillary canine inclusion and its treatment planning. Many different treatment approaches have been performed and, in particular, two surgical different techniques have been applied apparently without a real theoretical differentiation. Therefore, a detached research of international literature on the use of each surgical approach has been performed using the principal medical databases: PubMed (Medline), Lilacs and Scopus. The keywords used were: *Second Molars Impaction*, *Surgical Uprighting of Mandibular Molars*, *Orthodontic Uprighting of Mandibular Molars* and *Second Molars Surgery*; to identify all articles reporting on the topic till February 2019. No restrictions of time and languages have been fixed. The results have been filtered and valued following our eligibility criteria and then organized following the PRISMA method. The search identified 194 abstracts, which were reviewed manually and each article of interest was marked for further review. The full text of the marked studies was retrieved and studies that satisfied our eligibility criteria were included in this review. At the end only 5 full articles have been selected.

Results

Surgical Procedure

Ninety-seven patients underwent surgical uprighting of impacted mandibular second molars during the study period. Most were excluded because they did not have T0 and T1 panoramic radiographs. The final treatment group included 16 patients (68.7% female) with 19 uprighted second molars. The mean age at the time of the procedure and the average follow-up radiograph (T1) was obtained 2.4 Â± 1.4 years later (range, 12 months to 5 yr). The adjacent third molar was removed in 50% of cases. No preoperative images showed pathologic lesions in the path of eruption of the second molar, and no lesions were identified intraoperatively.

The control group included 16 patients (75% female) with a mean age at the time of the first radiograph (T0). The subsequent radiograph (T1) obtained was at an average follow-up of 3 years. There were no statistically relevant differences in gender, age, or follow-up time between the 2 groups.

For the treatment group, the distribution of impactions at T0, based on the Pell and Gregory classification, was type IA (n = 5; 26.4%), type IB (n = 9; 47.3%), type IC (n = 1; 5.3%), type IIB (n = 3; 15.7%), and type IIC (n = 1; 5.3%). At T1, all uprighted molars were type IA. The mean angle of the long axis of the impacted tooth to the occlusal plane was 122.6 Â± 34.9 Â± at T0 and 100.3 Â± 20.1 at T1.

The distance from the distal contact point of the first molar to the ascending ramus was 53.6% longer in the control group than in the treatment group at T0 ($P < .001$). From T0 to T1, this distance increased by 27.7% in the treatment group ($P < .001$) and by 11.9% in the control group ($P = .03$), and these changes were significantly different between groups ($P < .001$). There was no significant difference in this distance between those who did and those did not have simultaneous extraction of the adjacent third molar ($P = .497$).

Orthodontic Procedure

Overall, the orthodontic treatment achieved the planned occlusal and facial aesthetic goals. All impacted teeth were brought successfully into occlusion. The alignment of the mandibular second molars generally did not necessitate removal of the third molars, and there was a slight overcorrection of

the impacted mandibular second molar. Both the superior and inferior arches were well aligned with good incisal and buccal segment relationships and a mutually protected functional occlusion. The overjet has been maintained, and the increased overbite corrected. The MBT torque prescription for the maxillary labial segment led to an improved inclination of the maxillary anterior teeth. The chances of occlusal stability have been improved by establishing good incisal and buccal segment relationships.

The overall superimposition of the cephalometric radiographs showed downward and some forward growth of the maxilla and the mandible during treatment. Local superimposition on Bjork's structures suggests that the maxillary molars have remained in their position during treatment, and that the maxillary incisor inclination was corrected as planned. The mandibular superimposition shows mesial movement of the mandibular molars into the extraction space; this corrected the molar relationship. There was some mild proclination of the mandibular incisors that contributed to the improvement of the interincisal angle. The patients were pleased with the improvement in her appearance and is aware of the need to comply with the retention regimen and maintain excellent oral hygiene.

Discussion

Various methods of molar uprighting have been described in the literature. When the molars are severely displaced a continuous wire that uprights the molar is often thought to cause undesirable movement of the anchorage teeth such as tipping, rotation, intrusion, or extrusion of the adjacent teeth. Segmented mechanics have been advocated to prevent such side effects (T-loop spring[10]), and sectional uprighting springs have been designed for this specific purpose: eg, the Sander spring.[11] The placement of these adjuncts can be demanding on the operator and the patient. Trauma can occur to the mucosa of the buccal sulcus, depending on the anatomy of the patient's vestibular depth. Pushing the molars distally resulted in tipping, simultaneously creating space by moving the molars distally. To easily place the nickel-titanium push-coil spring between the first and second molars, the first molar attachments (tubes) had to be converted: ie, the buccal cover had to be removed. Most practitioners use banded attachments on second molars, but more recently posterior molar teeth are also often bonded, although bond strength for the latter is thought to be less than that for bands.[12] It can be difficult to band posterior teeth, particularly when they are only partially erupted or are impacted. Bands are also thought to be disadvantageous from a periodontal point of view, when compared with bonds. However, because of the horizontal position of the second molars and the limited amount of tooth surface available, bands can not be placed. This problem can be overcome by progressive repositioning of the bracket as the mandibular second molar became more accessible. The force (F) delivered by the wire is expressed by the formula: F z dr4/l3, where d is deflection of the wire, r is radius of the wire, and l is length. Therefore, bypassing a bracket results in increasing the effective length of the archwire, and the applied force levels subsequently decrease by the power of three. Conversely, the force levels increase as the diameter of the wire increases. As a result of bypassing the first molar bracket it was possible to use a rectangular thermally activated archwire. The use of a long rectangular archwire instead of a short round wire served several purposes. It saved on the number of archwires used and the chair time. The first wire that was engaged into the second molar bracket was rectangular, and it bypassed the first molar. On the next appointment, this same archwire was then engaged into the first molar bracket, thereby saving the removal of an archwire, if a smaller wire had been used. Bypassing the first molar bracket led to the reduction of the force levels and hence reduced the risk of inadvertent debonding of the second molar bracket, simultaneously allowing for some torque control during uprighting of the second molars. The use of a thermoelastic 0.016 3 0.022-in wire also eliminated the risk of permanent deformation during insertion of the archwire. A small round wire could have been used as an alternative here, but it would have been difficult to place because it had to be fully ligated into all brackets to be effective. Complete ligation would most likely lead to permanent deformation of the wire, rendering it ineffective. An archwire of a smaller diameter would also have needed replacement at later appointments. This demonstrates that second molar uprighting can be undertaken by using routine straight-wire mechanics without creating unwanted biomechanical side effects. Segmented and sectional mechanics were not used, nor were auxiliary springs. No wire-bending skills were required for this technique, and orthodontic assistants could carry out all of these detailed procedures, thus contributing to an efficient team approach for patient management.

In the surgical procedure, all surgically uprighted second molars were successfully moved to a vertical position. All periodontal defects on the distal aspect of

the first molar that were present before uprighting of the adjacent second molar resolved after the procedure, and no new periodontal defects developed. The rate of abnormal postoperative radiographic findings was 47.3%, but no patient developed pain, swelling, or other symptoms during the mean follow-up period of 2.4 years. Two (10.5%) uprighted teeth, which were asymptomatic, were ultimately extracted because of malposition or radiographic abnormalities. These results are consistent with published failure rates ranging from 0 to 4.5%. In a series of 22 surgically uprighted second molars by Pogrel,[13] 36.4% developed pulpal calcification and were non-vital on electric pulp testing postoperatively. None of these teeth were symptomatic. These and the present findings suggest that radiographic pulpal changes are not predictive of clinical failure. The available posterior eruption space at T0 was considerably smaller in the treatment group than in the control group in this series. This suggests lack of space for the second molar in the dental arch as an aetiology for failed eruption. Although pathology in the path of eruption is another likely aetiology for some cases, this was not seen in the present series.

Conclusion(s)

This study is able to report a significant success rate in both the surgical and orthodontic procedures. Some complications can be considered more relevant in the first kind of treatment but the experience of the operator and the starting condition of the teeth must be define as the principal factors for the definition of the treatment plan. More other clinical studies are necessary to improve the results of this review.

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